

**UTILITY  
PATENT APPLICATION  
TRANSMITTAL**

Attorney Docket No.

0083-1131-0

First Inventor or Application Identifier

Hideki HIRATA

Title

OPTICAL INFORMATION MEDIUM AND ITS FABRICATION PROCESS

jc520 U.S. PTO  
09/31/49



03/20/00

**APPLICATION ELEMENTS**

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO:

Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

1. ☒ Fee Transmittal Form (e.g. PTO/SB/17)  
(Submit an original and a duplicate for fee processing)

2. ☒ Specification Total Pages **18**

3. ☒ Drawing(s) (35 U.S.C. 113) Total Sheets **1**

4. ☒ Oath or Declaration Total Pages **3**

- a. ☒ Newly executed (original)  
b. ☐ Copy from a prior application (37 C.F.R. §1.63(d))  
(for continuation/divisional with box 15 completed)  
i. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting inventor(s) named  
in the prior application, see 37 C.F.R. §1.63(d)(2) and  
1.33(b).

5. ☐ Incorporation By Reference (usable if box 4B is checked)  
The entire disclosure of the prior application, from which a copy of the  
oath or declaration is supplied under Box 4B, is considered to be part  
of the disclosure of the accompanying application and is hereby  
incorporated by reference therein.

**ACCOMPANYING APPLICATION PARTS**

6. ☐ Assignment Papers (cover sheet & document(s))  
7. ☐ 37 C.F.R. §3.73(b) Statement ☐ Power of Attorney  
(when there is an assignee)  
8. ☐ English Translation Document (if applicable)  
9. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☒ Copies of IDS Citations (4)  
10. ☐ Preliminary Amendment  
11. ☒ White Advance Serial No. Postcard  
12. ☐ Small Entity Statement(s) ☐ Statement filed in prior application. Status still proper and desired.  
13. ☐ Certified Copy of Priority Document(s)  
(if foreign priority is claimed)  
14. ☒ Other: Notice of Priority, Statement of Relevancy

15. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application no.:  
Prior application information: Examiner: Group Art Unit:

16. Amend the specification by inserting before the first line the sentence:

☐ This application is a ☐ Continuation ☐ Division ☐ Continuation-in-part (CIP)  
of application Serial No. Filed on

☐ This application claims priority of provisional application Serial No. Filed

**17. CORRESPONDENCE ADDRESS**

OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C.  
FOURTH FLOOR  
1755 JEFFERSON DAVIS HIGHWAY  
ARLINGTON, VIRGINIA 22202  
(703) 413-3000  
FACSIMILE: (703) 413-2220

Name:	Norman F. Oblon	Registration No.:	24,618
Signature:		Date:	3/20/00
Name:	Registration No. 124	Registration No.:	

TITLE OF THE INVENTION  
OPTICAL INFORMATION MEDIUM AND ITS FABRICATION PROCESS  
BACKGROUND OF THE INVENTION

The present invention relates to an optical information  
5 medium such as read only optical disks and optical recording disks  
and its fabrication process.

In recent years, optical information media such as read only  
optical disks and optical recording disks have been required to  
have ever-higher recording densities and, hence, ever-higher  
10 capacities so as to record or store an enormous amount of  
information such as moving image information. To meet this  
requirement, media having such high recording densities are now  
under extensive and intensive research and development.

According to one of approaches proposed so far to this end,  
15 recording and reproducing wavelengths are shortened while the  
numerical aperture (NA) of an objective in a recording and  
reproducing optical system is increased, thereby reducing the  
diameter of recording and reproducing laser beams, as typically  
practiced in the case of a digital versatile disk or DVD. When  
20 the recording and reproducing wavelength is decreased from 780  
nm down to 650 nm and the NA is increased from 0.45 up to 0.6,  
the recording capacity of the DVD is 4.7 GB/surface or 6 to 8  
times as large as that of a CD.

As the NA increases, however, the tilt margin decreases.  
25 The tilt margin is the tolerance of the tilt of an optical  
recording medium with respect to an optical system, and is  
determined by the NA. Here let  $\lambda$  be a recording and reproducing  
wavelength and  $t$  be the thickness of a transparent substrate on  
which recording and reproducing light is incident. Then, the  
30 tilt margin is proportional to:

$$\lambda / (t \cdot NA^3)$$

As the optical recording medium tilts with respect to a laser  
beam, wavefront aberration (coma) occurs. Here let  $n$  denote the  
refractive index of the substrate and  $\theta$  stand for the angle of  
35 tilt. Then, the wavefront aberration coefficient is given by:

$$(1/2) \cdot t \cdot \{n^2 \cdot \sin \theta \cdot \cos \theta\} \cdot NA^3 / (n^2 - \sin^2 \theta)^{-5/2}$$

From these expressions, it is understood that the thickness  $t$  of the substrate should preferably be reduced to increase the tilt margin and prevent the occurrence of coma. In a DVD, indeed, the tilt margin is ensured by making the thickness of the substrate about half (ca. 0.6 mm) the thickness (ca. 1.2 mm) of the substrate of a CD. On the other hand, the thickness variation margin for the substrate is given by:

$$\lambda/NA^4$$

When there a thickness variation in the substrate, another wavefront aberration (spherical aberration) occurs. Here let  $\Delta t$  be the thickness variation of the substrate. Then, the spherical aberration coefficient is given by:

$$\{(n^2 - 1)/8n^3\} \cdot NA^4 \cdot \Delta t$$

From these expressions, it is understood that to reduce the spherical aberration produced with an increasing NA, it is required to reduce the thickness variation as much as possible. For instance,  $\Delta t$  is of the order of  $\pm 100 \mu\text{m}$  in the case of a CD whereas  $\Delta t$  is limited to  $\pm 30 \mu\text{m}$  in the case of a DVD.

To record moving images of higher quality over an extended period of time, a structure enabling a substrate to become thinner has been put forward in the art. According to this structure, a substrate having an ordinary thickness is used as a supporting substrate for maintaining rigidity. Pits or a recording layer are formed on the surface of the substrate. A light-transmitting layer of about 0.1 mm in thickness is provided as a thin substrate on the recording layer, so that recording and reproducing light can be incident on the recording layer through the light-transmitting layer. With this structure, it is possible to achieve an ever-higher NA and, hence, an ever-higher recording density, because the substrate can be made much thinner than could be possible with conventional structures.

However, it is very difficult to form the light-transmitting layer used for this structure, using resin injection molding. To eliminate such difficulty, it has been proposed to form such a light-transmitting layer by spin-coating of an ultraviolet-curing resin, as typically disclosed in JP-A 9-161333. In JP-A 10-269624, it is proposed to coat a dispersion

of spacer particles in a photo-curing resin on a substrate and press the dispersion down on the substrate with a plate material, thereby forming a light-transmitting layer of uniform thickness. In JP-A 10-283683, it is proposed to bond an ultraviolet-curing  
5 resin onto a light-transmitting sheet.

When a light-transmitting layer is formed by the processes set forth in the aforesaid publications, however, a medium warping problem arises due to shrinkage upon curing of the resin forming part of the light-transmitting layer. When the  
10 photo-curing resin is formed into a film of about 0.1 mm in thickness, it is difficult to achieve uniform curing in the thickness direction. As a result, the light-transmitting layer lacks optical uniformity, and the reliability of the medium is likely to become low due to the presence of uncured monomers.  
15 According to the process shown in the aforesaid JP-A 10-283683, the ultraviolet-curing resin layer is thinner than those obtained by other processes because the ultraviolet-curing resin is used as an adhesive layer, and so the medium is less susceptible to warpage. However, the distortion by shrinkage of the resin  
20 upon ultraviolet curing leads to another problem that the index of double refraction of the light-transmitting sheet becomes large.

An object of the present invention is to provide an optical information medium comprising a supporting substrate, an  
25 information-recording surface provided on a surface of said supporting substrate and a light-transmitting layer provided on said information-recording surface and formed of a resin, wherein said light-transmitting layer is allowed to have a uniform thickness so that optical heterogeneity of the  
30 light-transmitting layer, especially an increase in the birefringence of the light-transmitting layer can be reduced, and any warping of the optical information medium is prevented.

#### SUMMARY OF THE INVENTION

Such an object is achievable by the inventions recited below  
35 as (1) to (6).

(1) An optical information medium comprising a supporting substrate, an information-recording surface provided on the

supporting substrate and a light-transmitting layer provided on the information-recording surface, with recording light and/or reproducing light incident on the information-recording surface through the light-transmitting layer, wherein:

5        said light-transmitting layer comprises a light-transmitting sheet formed of a resin and an adhesive layer containing pressure-sensitive adhesive for bonding said light-transmitting sheet to an associated side of said supporting substrate.

10        (2) The optical information medium according to (1), wherein said adhesive layer contains a transparent acrylic resin.

15        (3) The optical information medium according to (1), wherein said light-transmitting sheet is formed of one resin selected from polycarbonate, polyarylate and cyclic polyolefin.

      (4) The optical information medium according to (1), wherein said light-transmitting sheet has been prepared by a casting technique.

20        (5) The optical information medium according to (1), wherein said light-transmitting sheet has a thickness of 30 to 300  $\mu\text{m}$ .

25        (6) A process of fabricating an optical information medium as recited in (1), which comprises a step of bonding a light-transmitting sheet larger than said supporting substrate to an associated side of said supporting substrate, and then cutting off a region of said light-transmitting sheet that is unbonded to said supporting substrate by laser processing.

#### BRIEF EXPLANATION OF THE DRAWING

30        Fig. 1 is a partial sectional view of one embodiment of the optical information medium according to the invention.

#### EMBODIMENTS OF THE INVENTION

35        One exemplary arrangement of the optical information medium according to the invention is shown in Fig. 1. This optical information medium is an information recording medium comprising a supporting substrate 20 and an information recording surface or a recording layer 4 provided on the supporting substrate 20. This recording layer 4 includes thereon a light-transmitting

layer 2. Recording light and/or reproducing light are incident on the recording layer 4 through the light-transmitting layer 2. The present invention may be applied to every optical recording medium irrespective of the type of the recording layer: for instance, a phase change type recording medium, a pit type recording medium, and a magneto-optical recording medium. Usually, a dielectric layer and a reflective layer are provided on at least one side of the recording layer for the purposes of protecting the recording layer, ensuring optical effects, and so on, although not shown in Fig. 1. The present invention may also be applied to the read only type to say nothing of the recordable type shown in Fig. 1. In this case, rows of pits formed integrally with the supporting substrate 20 define the information-recording surface.

In the optical information medium shown in Fig. 1, the light-transmitting layer 2 is built up of a light-transmitting sheet 201 and an adhesive layer 202 for bonding the light-transmitting sheet 201 to the associated side of the supporting substrate 20. The adhesive layer 202 is made up of a pressure-sensitive adhesive that is transparent to recording and reproducing light and has an adhesion strong-enough to bond the light-transmitting sheet to a layer present on the surface of the supporting substrate.

The use of the adhesive agent for the bonding of the light-transmitting sheet to the associated side of the supporting substrate has the following advantages:

(1) Curing is unnecessary unlike an ultraviolet-curing adhesive agent; the medium is less susceptible to warpage due to no distortion by shrinkage of resin upon curing.

(2) Curing is unnecessary with no distortion by shrinkage of resin upon curing, resulting in little or no increase in the index of birefringence of the light-transmitting sheet.

(3) Any curing step is not needed, and so the equipment used can be simplified.

(4) The adhesive layer can be previously formed as a coating film on the light-transmitting sheet, and so can have a reduced thickness profile. Thus, the problems arising so far

from the combination of the light-transmitting sheet with the ultraviolet-curing adhesive agent can be eliminated by the present invention.

For the constituent of the adhesive layer, pressure-sensitive adhesives, for instance, any of acrylic resins, silicone resins and rubber materials may be used. In the practice of the invention, however, it is preferable to use an acrylic resin because of being excellent in optical properties, ensuring a wide design margin concerning adhesion and heat resistance, and being inexpensive as well.

No particular limitation is imposed on how to form the adhesive layer in the practice of the invention. However, it is preferable to make use of a process that enables the adhesive agent to be coated on the light-transmitting sheet with a uniform thickness. It is also preferable to make use of an adhesive sheet obtained by coating an adhesive agent on both sides of a transparent base film. Then, this adhesive sheet is used as the adhesive layer in the present invention, so that the light-transmitting sheet can be bonded to the associated side of the supporting substrate. No particular limitation is again imposed on how to coating the adhesive agent; a suitable selection may be made from die coating, roll coating, gravure coating, dip coating and the like. However, it is preferable to make use of die coating because reduced film thickness profiles are achievable.

No particular limitation is placed on how the light-transmitting sheet is actually laminated on the associated side of the supporting substrate using the adhesive layer. For instance, when the present invention is applied to an optical disk, a disk form of light-transmitting sheet previously configured to conform substantially to the shape and size of the supporting substrate may be laminated on the associated side of the supporting substrate. Alternatively, a light-transmitting sheet blank may first be laminated on the associated side of the supporting substrate, and then configured to a disk by removing a portion of the blank that is not bonded to the associated side of the supporting substrate. In view of mass productivity and

5 fabrication cost reductions, however, the latter is preferred. For instance, it is preferable to make use of a method wherein a long length of light-transmitting sheet blank is continuously laminated on a multiplicity of disks using a laminator or the like, and unnecessary regions of the blank are then trimmed off. Preferably but not exclusively, press punching and cutting are used as the trimming means. However, it is preferable to make use of laser processing because burrs and cuttings do not occur at the laser-trimmed ends of the light-transmitting sheet. For  
10 laser processing, an ordinary laser trimmer is used.

The thickness of the adhesive layer may be appropriately determined in such a way that uniform thickness is obtainable and sufficient adhesive power is achievable. However, the adhesive layer should have a thickness of preferably 5 to 70  $\mu\text{m}$ ,  
15 and more preferably 10 to 50  $\mu\text{m}$ . At too small a thickness, the adhesion of the adhesive layer becomes worse, with lamination yield drops. With too thick an adhesive layer, on the other hand, the film thickness profile becomes large; that is, it is required to make the light-transmitting sheet thinner.

20 The light-transmitting sheet should preferably be formed of at least one resin selected from polycarbonate, polyarylate and cyclic polyolefin.

No particular limitation is imposed on the polycarbonate used herein; for instance, a generally available bisphenol type  
25 of aromatic polycarbonate may be used. For the polycarbonate sheet prepared by the casting technique to be described later, for instance, Pure Ace (Teijin Limited) is commercially available.

The polyarylate is a polyester of a divalent phenol and an  
30 aromatic dicarboxylic acid. The polyarylate used herein is a noncrystalline polyarylate; however, it is particularly preferable to use a condensation polymer of bisphenol A and terephthalic acid. The polyarylate is susceptible to double refraction because of having an aromatic ring as is the case with  
35 polycarbonate; however, this is higher in heat resistance than polycarbonate. For the polyarylate sheet prepared by the casting technique to be referred to later, for instance, Elmeck



(Kanegafuchi Chemical Industry Co., Ltd.) is commercially available.

The cyclic polyolefin used herein should preferably be excellent in light transmission. The cyclic polyolefin  
5 excellent in light transmission, for instance, includes a noncrystalline, cyclic polyolefin starting from a norbornene compound. This is also excellent in heat resistance. In the practice of the invention, use may be made of commercially available cyclic polyolefins such as Arton (JSR Co., Ltd.),  
10 Zeonex (Nippon Zeon Co., Ltd.) and Apel (Mitsui Chemical Industry Co., Ltd.). Of these, Arton and Zeonex are commercially available in film forms. Arton and Zeonex are the products obtained by the ring-opening polymerization and hydrogenation of the norbornene monomer. Arton is easily soluble in a solvent  
15 because an ester group is introduced in the side chain of the norbornene monomer. This polymer is preferred for the reasons that the solvent casting technique to be referred to later can be used for sheet-making, its adhesion strength to the adhesive layer can be enhanced due to its good adhesion to an organic  
20 material, and it is unlikely to attract dust due to its low chargeability.

No particular limitation is imposed on how to make the light-transmitting sheet. However, it is difficult to make such a light-transmitting sheet as used herein by means of  
25 conventional injection molding because of its thinness. It is thus preferable to make use of techniques enabling resin to be configured in a film form such as the solvent casting technique and a melt extrusion technique. Of these, preference is given to the casting technique such as one described typically in JP-B  
30 3-75944. The publication discloses a casting process by which a flexible disk excellent in transparency, birefringence, flexibility, surface accuracy and thickness uniformity can be produced. In the practice of the invention, it is preferable to make use of this casting process to prepare the light-  
35 transmitting sheet. According to this casting process, the light-transmitting sheet can be prepared through the following steps.

(1) A resin pellet such as a polycarbonate pellet is dissolved in a solvent such as methylene chloride, acrylonitrile and methyl acrylate.

(2) After fully stirred, defoamed and filtered, the  
5 solution is continuously cast on a mold having high surface accuracy through a die.

(3) The cast product is passed through a drying furnace to evaporate off the solvent, and then continuously rolled up.

The light-transmitting sheet prepared by such a solvent  
10 casting process is smaller in birefringence than that prepared by a general melt extrusion process because the tension applied on the sheet is small. A sheet prepared by the melt extrusion process, in contrast, gives rise to a birefringence profile in the stretching direction. With this solvent casting process,  
15 a sheet having an excellent surface state and a uniform thickness can be prepared by proper control of the rate of evaporation of the solvent, and such die line flaws as found in a sheet prepared by the melt extrusion process do not occur.

It is here noted that whether the light-transmitting sheet  
20 has been prepared by the solvent casting process or not can be checked depending on whether or not an isotropic birefringence pattern is found. This may also be checked by gas chromatography or other qualitative analysis of the solvent remaining in the sheet.

The thickness of the light-transmitting layer should  
25 preferably be selected from the range of 30 to 300  $\mu\text{m}$ . Too thin a light-transmitting layer is susceptible to some considerable optical influence due to dust attracted on its surface. On the other hand, a light-transmitting layer having a thickness  
30 exceeding the aforesaid upper limit may be formed by injection molding or other molding processes.

The supporting substrate 20 is provided to maintain the rigidity of the medium. The substrate 20 has usually a thickness of 0.2 to 1.2 mm, and preferably 0.4 to 1.2 mm, and may be either  
35 transparent or opaque. An guide groove usually provided in an optical recording medium may be formed by transfer of a groove provided in the supporting substrate 20 during the formation of

the light-transmitting layer, as shown in Fig. 1. A guide groove 21 shown in Fig. 1 is concave toward the side of the medium on which light is incident.

#### EXAMPLES

##### 5 Example 1

Read only optical disk samples shown in Table 1 were prepared through the following process steps.

##### Sample No. 1

10 By sputtering, a reflective film made of an Al alloy was formed on the surface of a disk form of supporting substrate (a polycarbonate substrate of 120 mm in diameter and 1.2 mm in thickness) having asperities defining pits for carrying information thereon, as seen from the light-transmitting layer side.

15 Then, a polycarbonate sheet (having a thickness of 70  $\mu\text{m}$  and an index of double refraction of 20 nm) was bonded as a light-transmitting sheet to the surface of the reflecting film with an adhesive layer of 30  $\mu\text{m}$  in thickness interleaved between them. The polycarbonate sheet used herein had been previously  
20 configured to conform to the shape and size of the supporting substrate. For the adhesive layer, a double-sided adhesive sheet was used, which was prepared by coating an acrylic resin adhesive agent on both sides of a transparent base. This polycarbonate was Pure Ace (Teijin Limited) prepared by the  
25 aforesaid casting process, and having a glass transition point of 145°C and a molecular weight of about 40,000.

##### Sample No. 2

This sample was prepared according to sample No. 1 with the exception that a polycarbonate sheet (having a thickness of 70  
30  $\mu\text{m}$  and an index of double refraction of 90 nm) made by melt extrusion was used as the light-transmitting sheet. The polycarbonate itself was the same as that used for sample No. 1.

##### Sample No. 3 (for comparison)

35 An acrylic type of ultraviolet-curing adhesive (DVD-003 made by Nippon Kayaku Co., Ltd.) was spin-coated on the surface of a reflective film to form an adhesive layer of 30  $\mu\text{m}$  in

thickness thereon. Then, the polycarbonate sheet used for sample No. 1 was bonded onto the adhesive layer to obtain a light-transmitting layer.

Sample No. 4 (for comparison)

- 5        This sample was prepared following sample No. 3 with the exception that the same polycarbonate sheet as in sample No. 2 was used as the light-transmitting sheet.

Sample No. 5 (for comparison)

- 10       An ultraviolet-curing resin (SD-301 made by Dainippon Ink & Chemicals, Inc.) was spin-coated on the surface of a reflective film, and irradiated with ultraviolet rays for curing, thereby obtaining a light-transmitting layer of 100  $\mu\text{m}$  in thickness.

Sample No. 6

- 15       This sample was prepared following sample No. 1 with the exception that a cyclic polyolefin sheet (having a thickness of 70  $\mu\text{m}$  and an index of birefringence of 10 nm) made by the casting process was used as the light-transmitting sheet. The cyclic polyolefin sheet used herein was an Arton sheet (made by JSR Co., Ltd. and having a glass transition point of 170°C).

- 20       Sample No. 7 (for comparison)

      This sample was prepared following sample No. 3 with the exception that the same cyclic polyolefin sheet as in sample No. 6 was used as the light-transmitting sheet.

Sample No. 8

- 25       This sample was prepared following sample No. 1 with the exception that a polyarylate sheet (having a thickness of 70  $\mu\text{m}$  and an index of birefringence of 25 nm) made by the casting process was used. The polyarylate sheet used herein was an Elmech sheet (made by Kanegafuchi Chemical Industry Co., Ltd., and having a  
30       glass transition point of 200°C).

Sample No. 9 (for comparison)

      This sample was prepared following sample No. 3 with the exception that the same polyarylate sheet as in sample No. 8 was used as the light-transmitting sheet.

- 35       Estimation

      For each sample, the thickness profile of the light-transmitting layer (the maximum value - the minimum value) and

the amount of warpage were measured. The results are given in Table 1. The thickness profile was measured within a region located at a 25-58 mm radius position of the sample, using a laser focus displacement meter made by Keyence. The amount of warpage was measured using a mechanical accuracy measuring device made by Ono Sokki Co, Ltd., while light was allowed to strike on the light-transmitting layer from the supporting substrate side. The measuring linear rate was 4 m/s.

The index of double refraction of the light-transmitting layer was measured using a rotary analyzer type birefringence meter made by Admon Science. The results are given in Table 1. The index of double refraction was measured for the ultraviolet-cured resin layer in sample No. 5 and for the adhesive layer or the laminated assembly of the adhesive layer and light-transmitting sheet in other samples.

00000" 5444.360

Table 1

Sample No.	Bonding Means	Material for Light-Transmitting Sheet	Light-Transmitting Sheet Making Process	Thickness			Amount of warpage	Double Refraction
				( $\mu\text{m}$ )	(deg)	(nm)		
1	Pressure-Sensitive Adhesive	polycarbonate	Casting	2	0.20	20		
2	Pressure-Sensitive Adhesive	polycarbonate	Melt Extrusion	4	0.22	130		
3 (comp.)	UV-Curing Adhesive	polycarbonate	Casting	14	0.72	40		
4 (comp.)	UV-Curing Adhesive	polycarbonate	Melt Extrusion	18	0.75	200		
5 (comp.)	UV-Curing Adhesive	—	—	25	Unmeasurable	10		
6	Pressure-Sensitive Adhesive	Cyclic Polyolefin	Casting	3	0.24	15		
7 (comp.)	UV-Curing Adhesive	Cyclic Polyolefin	Casting	17	0.65	25		
8	Pressure-Sensitive Adhesive	Polyarylate	Casting	3	0.26	30		
9 (comp.)	UV-Curing Adhesive	Polyarylate	Casting	20	0.68	40		

From Table 1, the advantages of the invention are evident. From comparisons of No. 1 with No. 3, No. 2 with No. 4, No. 6 with No. 7 and No. 8 with No. 9, it is found that the uniformity, amount of warpage and index of double refraction of the light-transmitting layer are strikingly improved by bonding the light-transmitting sheet to the side of the supporting substrate using the adhesive layer. From a comparison of No. 1 with No. 2, it is then found that the increase in the birefringence of the polycarbonate sheet can be almost perfectly reduced by combining the polycarbonate sheet with the adhesive agent. Regarding the cyclic polyolefin sheet and polyarylate sheet, too, the index of double refraction can be strikingly reduced by preparing them by the casting process, as is the case with the polycarbonate sheet.

The sample referred to as "unmeasurable" in Table 1 could not be measured due to too large warpage.

#### Example 2

##### Sample No. 10

By sputtering, a reflective film made of an Al alloy was formed on the surface of a disk form of supporting substrate (a polycarbonate substrate of 120 mm in diameter and 1.2 mm in thickness) having asperities defining pits for carrying information thereon, as seen from the light-transmitting layer side.

Then, a transparent acrylic adhesive agent of 30  $\mu\text{m}$  in thickness was coated by roll coating on one surface of a light-transmitting sheet of 300 mm in width and 100 m in length. This light-transmitting sheet was a polycarbonate sheet (made by Nitto Denko Co., Ltd.) made by the casting process and having a thickness of 70  $\mu\text{m}$ .

Then, the light-transmitting sheet was laminated on the surface of the reflecting film, using a laminator (made by MKC). Subsequently, a region of the light-transmitting sheet unbonded to the surface of the reflective film was trimmed off by a laser trimmer, thereby configuring the light-transmitting sheet in conformity to the shape (disk shape having a center hole) of the

supporting substrate. The time taken for trimming was 10 seconds.

Sample No. 11

5 This sample was prepared following sample No. 10 with the exception that the light-transmitting sheet was configured by press punching. The time taken for press punching was 20 seconds.

Sample No. 12

10 This sample was prepared following sample No. 10 with the exception that the light-transmitting sheet was configured by lathe processing. The time taken for lathe processing was 2 minutes.

Estimation

15 For each sample, the inner and outer peripheral ends of the light-transmitting sheet were visually observed. As a result, sample No. 11 was found to have burrs due to press punching whereas sample No. 12 was found to have the light-transmitting sheet turned up. In sample No. 10, in contrast, neither burrs nor such a turning-up were found. The thickness profile (the maximum  
20 value - the minimum value) of each sample at its outer peripheral portion (at a 58 mm radius position) in its peripheral direction was measured, using a laser focus displacement meter made by Keyence). As a consequence, sample No. 10 was found to have a small value of 3  $\mu\text{m}$  in contrast of 8  $\mu\text{m}$  for sample No. 11 and  
25 13  $\mu\text{m}$  for sample No. 12.

From these results, the effect obtained by use of laser processing is evident.

EFFECT OF THE INVENTION

30 In the present invention, the light-transmitting sheet made of resin is bonded to the supporting substrate using the adhesive layer, so that the light-transmitting layer can have a uniform thickness while the increase in the birefringence of the light-transmitting sheet can be reduced, and the warping of the optical recording medium can be reduced.

35 Japanese Patent Application No. 76951/1999, 148602/1999 and 326101/1999 are incorporated herein by reference.



5

WHAT WE CLAIM IS:

1. An optical information medium comprising a supporting substrate, an information-recording surface provided on the supporting substrate and a light-transmitting layer provided on the information-recording surface, with recording light and/or reproducing light incident on the information-recording surface through the light-transmitting layer, wherein:

said light-transmitting layer comprises a light-transmitting sheet formed of a resin and an adhesive layer containing pressure-sensitive adhesive for bonding said light-transmitting sheet to an associated side of said supporting substrate.

2. The optical information medium according to claim 1, wherein said adhesive layer contains a transparent acrylic resin.

3. The optical information medium according to claim 1, wherein said light-transmitting sheet is formed of one resin selected from polycarbonate, polyarylate and cyclic polyolefin.

4. The optical information medium according to claim 1, wherein said light-transmitting sheet has been prepared by a casting technique.

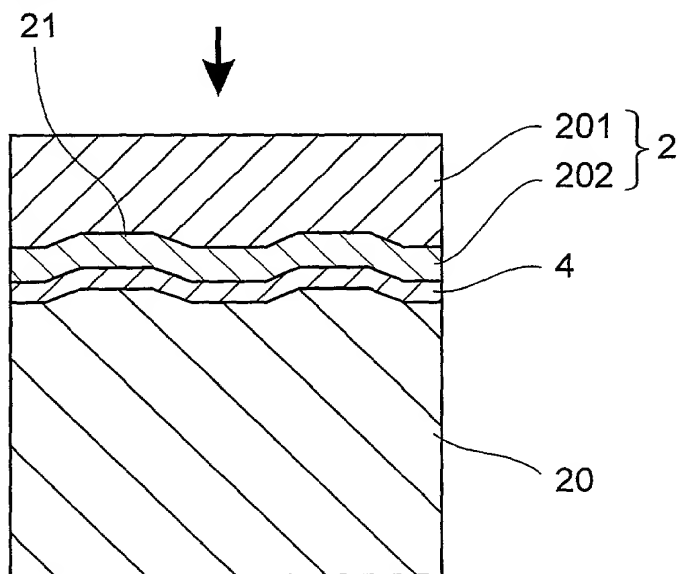
5. The optical information medium according to claim 1, wherein said light-transmitting layer has a thickness of 30 to 300  $\mu\text{m}$ .

6. A process of fabricating an optical information medium as recited in claim 1, which comprises a step of bonding a light-transmitting sheet larger than said supporting substrate to an associated side of said supporting substrate, and then cutting off a region of said light-transmitting sheet that is unbonded to said supporting substrate by laser processing.

An optical information medium comprises a supporting substrate 20, an information recording surface 4 on the supporting substrate 20 and a light-transmitting layer 2 on the information recording surface 4. Recording light and/or reproducing light are incident on the information recording surface 4 through the light-transmitting layer 2. The light-transmitting layer 2 comprises a light-transmitting sheet 201 formed of a resin such as polycarbonate, cyclic polyolefin and polyarylate and an adhesive layer 202 for bonding the light-transmitting sheet 201 to an associated side of the supporting substrate.

FIG. 1

RECORDING AND REPRODUCING LIGHT



# Declaration and Power of Attorney For Patent Application

## 特許出願宣言書及び委任状

### Japanese Language Declaration

#### 日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

OPTICAL INFORMATION MEDIUM

AND ITS FABRICATION PROCESS

上記発明の明細書は、

the specification of which

☐ 本書に添付されています。

☒ is attached hereto.

☐ \_\_\_\_月\_\_\_\_日に提出され、米国出願番号または特許協定条約国際出願番号を\_\_\_\_とし、  
(該当する場合) \_\_\_\_に訂正されました。

☐ was filed on \_\_\_\_\_  
as United States Application Number or  
PCT International Application Number  
\_\_\_\_\_ and was amended on  
\_\_\_\_\_ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration  
(日本語宣言書)

私は、米国法典第35編119条 (a) - (d) 項又は365条 (b) 項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約365 (a) 項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)

<u>11-076951</u>	<u>Japan</u>
(Number)	(Country)
<u>11-148602</u>	<u>Japan</u>
<u>11-326101</u>	<u>Japan</u>
(Number)	(Country)

私は、第35編米国法典119条 (e) 項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

(Application No.) (出願番号)	(Filing Date) (出願日)
私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条 (c) に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。	

(Application No.) (出願番号)	(Filing Date) (出願日)
-----------------------------	------------------------

(Application No.) (出願番号)	(Filing Date) (出願日)
-----------------------------	------------------------

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じることに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

	Priority Claimed
<u>19/March/1999</u> (Day/Month/Year Filed)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<u>27/May/1999</u> (Day/Month/Year Filed)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<u>16/November/1999</u> (Day/Month/Year Filed)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)
I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.	

(Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済)
---

(Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済)
---

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration  
(日本語宣言書)

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。  
(弁理士、または代理人の指名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

Norman F. Oblon, Reg. No. 24,618; Marvin J. Spivak, Reg. No. 24,913; C. Irvin McClelland, Reg. No. 21,124; Gregory J. Maier, Reg. No. 25,599; Arthur I. Neustadt, Reg. No. 24,854; Richard D. Kelly, Reg. No. 27,757; James D. Hamilton, Reg. No. 28,421; Eckhard H. Kuesters, Reg. No. 28,870; Robert T. Pous, Reg. No. 29,099; Charles L. Gholz, Reg. No. 26,395; Vincent J. Sunderdick, Reg. No. 29,004; William E. Beaumont, Reg. No. 30,996; Robert F. Gnuse, Reg. No. 27,295; Jean-Paul Lavalleye, Reg. No. 31,451; Stephen G. Baxter, Reg. No. 32,884; Martin M. Zoltick, Reg. No. 35,745; Robert W. Hahl, Reg. No. 33,893; Richard L. Treanor, Reg. No. 36,379; Steven P. Weihrouch, Reg. No. 32,829; John T. Goolkasian, Reg. No. 26,142; Richard L. Chinn, Reg. No. 34,305; Steven E. Lipman, Reg. No. 30,011; Carl E. Schlier, Reg. No. 34,426; James J. Kulbaski, Reg. No. 34,648; Richard A. Neifeld, Reg. No. 35,299; J. Derek Mason, Reg. No. 35,270; Surinder Sachar, Reg. No. 34,423; Christina M. Gadiano, Reg. No. 37,628; Jeffrey B. McIntyre, Reg. No. 36,867; and Paul E. Rauch, Reg. No. 38,591 with full powers of substitution and revocation.

書類送付先

Send Correspondence to:

OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C.  
FOURTH FLOOR  
1755 JEFFERSON DAVIS HIGHWAY  
ARLINGTON, VIRGINIA 22202 U.S.A.

直接電話連絡先：(名前及び電話番号)

Direct Telephone Calls to: (name and telephone number)  
(703) 413-3000

単独発明者または第一の共同発明者の氏名	Full name of sole or first joint inventor Hideki HIRATA
発明者の署名	Inventor's signature Hideki Hirata
日付	Date March 3, 2000
住所	Residence c/o TDK CORPORATION of 1-13-1, Nihonbashi, Chuo-ku, Tokyo, 103-8272, Japan
国籍	Citizenship Japan
郵便の宛先	Post Office Address Same as above
第二の共同発明者の氏名	Full name of second joint inventor, if any
第二の共同発明者の署名	Second joint Inventor's signature
日付	Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

(第三以降の共同発明者についても同様に記載し、署名すること)

(Supply similar information and signature for third and subsequent joint inventors.)